

IN THE CLAIMS:

1 1. (Currently Amended) A rotary tool for drilling into a
2 soil formation from its surface, controllably injecting water and
3 dry binder at known depths below the surface of said formation,
4 and mixing said soil, water and dry binder to form an in-situ
5 piling, said tool comprising:

6 a rotary shaft having a central axis of rotation
7 adapted to be driven bi-directionally around said axis, and bi-
8 directionally along said axis;

9 a vane on and extending radially from said shaft to be
10 rotated around and moved axially by said shaft, said vane being
11 so disposed and arranged as to move through the formation along a
12 helical path to drill into said formation, to stir the material
13 of the formation, and ultimately to mix the material of the
14 formation with water and dry binder;

15 a water injector and a binder injector carried by said
16 tool, each injector having a respective axis of emission of water
17 or of dry binder, said axes of emission being directed away from
18 said tool into said formation at a respective location along said
19 central axis;

20 said injectors being so disposed and arranged relative
21 to one another that the material of their emissions will during a
22 limited number of revolutions of said shaft, encounter one
23 another, there to be mixed as a pre-determined ratio of water and

24 of dry binder, said water including water emitted from the water
25 injector and water which may have already been present at that
26 location;

27 said injectors being set in said shaft with their axes of
28 emission substantially normal to said central axis, and located
29 along said central axis such that the emission of one of them
30 will, within a limited number or rotations of the shaft encounter
31 and mix with the other in a temporally suitable time related to
32 the curing of the binder and drainage of the water;

33 there being pair of said water injectors and at least one of
34 said binder injectors set in said shaft, with said binder
35 injector located axially between said water injectors.

1 Claim 2 (cancelled)

2 Claim 3 (cancelled)

3 Claim 4 (cancelled)

4 Claim 5 (cancelled)

5 Claim 6 (cancelled)

6 Claim 7 (cancelled)

7 Claim 8 (cancelled)

8 Claim 9 (cancelled)

1 10. (Currently Amended) In combination:

2 A-retary-tool-according-to-claim-1;-and

3 a rotary tool for drilling into a soil formation from
4 its surface, controllably injecting water and dry binder at known
5 depths below the surface of said formation, and mixing said soil,
6 water and dry binder to form an in-situ piling, said tool
7 comprising:

8 a rotary shaft having a central axis of rotation
9 adapted to be driven bi-directionally around said axis, and bi-
10 directionally along said axis;

11 a vane on and extending radially from said shaft to be
12 rotated around and moved axially by said shaft, said vane being
13 so disposed and arranged as to move through the formation along a
14 helical path to drill into said formation, to stir the material
15 of the formation, and ultimately to mix the material of the
16 formation with water and dry binder;

17 a water injector and a binder injector carried by said
18 tool, each injector having a respective axis of emission of water
19 or of dry binder, said axes of emission being directed away from
20 said tool into said formation at a respective location along said
21 central axis;

22 said injectors being so disposed and arranged relative
23 to one another that the material of their emissions will during a
24 limited number of revolutions of said shaft, encounter one
25 another, there to be mixed as a pre-determined ratio of water and
26 of dry binder, said water including water emitted from the water

injector and water which may have already been present at that location;

a control valve respective to each of said injectors, whereby the rate of supply of water and of dry binder can independently be regulated by said control valves to provide binder at a rate desired at a respective depth and water at a rate desired which with existing water already in the formation at that depth, will constitute at least sufficient water for stoichiometric reaction of the binder;

said injectors being set in said shaft with their axes of emission substantially normal to said central axis, and located along said central axis such that the emission of one of them will, within a limited number of rotations of the rotary tool encounter and mix with the other in a temporally suitable time related to the curing of the binder and drainage of the water.

Claim 11 (cancelled)

Claim 12 (cancelled)

Claim 13 (cancelled)

Claim 14 (cancelled)

Claim 15 (cancelled)

Claim 16 (cancelled)

Claim 17 (cancelled)

Claim 18 (cancelled)

9 Claim 19 (cancelled)

1 20. (Currently Amended) The method of forming an in-situ
2 piling in a soil formation with a dry binder and sufficient water
3 to produce a stoichiometrically correct mixture, comprising:

4 with a rotary tool, drilling into said formation, said
5 tool having a rotary shaft that has a central axis of rotation
6 and a vane for drilling into and mixing the soil, rotated around
7 and moved axially by said shaft, said vane being so disposed and
8 arranged as to move through the formation along a helical path to
9 drill into said formation, to stir the material of the formation,
10 and ultimately to mix the material of the formation with water
11 and binder;

12 a water injector and a dry binder injector carried by
13 said tool;

14 driving said tool axially into and out of said
15 formation while rotating it;

16 at some times during axial movement of said tool,
17 discharging-water-or-dry-binder-from-a-respective-injector-into
18 said-soil-formation-along-a-respective-axis-of-emission-of-water
19 or-of-said-binder,-said-axes-of-emission-being-directed-away-from
20 said-tool-into-said-formation-at-a-respective-location-along-said
21 central-axis,-so-that-the-material-of-their-emissions-will-during
22 a-limited-number-of-revolutions-of-said-shaft-encounter-one

23 another,--there-to-be-mixed-as-a-pre-determined-ratio-of-water-and
24 of-binder,--said-water-including-water-emitted-from-the-water
25 injector-and-water-which-may-have-already-been-present-at-that
26 depth.

27 discharging said water from said water injector into said soil
28 formation along an axis of emission of said water and discharging
29 said dry binder from said binder injection into said soil
30 formation along an axis of emission of said dry binder under
31 continuous control of the rate of supply of each, both said axes
32 of emission being radially directed away from said tool into said
33 soil formation at a respective location along said central axis
34 of said shaft, so that said water and said dry binder being
35 emitted from said water injector and said binder injector,
36 respectively, will during a limited number of revolutions of said
37 shaft encounter one another to become a mixture at various depths
38 with a as a pre-determined ratio of water and dry binder, said
39 ratio being responsive to requirements at the respective depth
40 said water including water emitted from said water injector and
41 water which may have already been present at that depth in said
42 soil formation, said mixture of water and binder further
43 including material of the formation being temporally made.

1 21. (Original) The method of claim 20 in which injection of
2 binder is made during passage of said tool into said soil

3 formation.

1 22. (Original) The method of claim 20 in which injection of
2 binder is made during passage of said tool out of said soil
3 formation.

1 23. (Original) The method of claim 20 in which injection of
2 water is made during passage of said tool into said soil
3 formation.

1 24. (Original) The method of claim 20 in which injection of
2 water is made during passage of said tool out of said soil
3 formation.

1 Claim 25 (cancelled)

1 26.(Original) The method of claim 20 in which the emission
2 of one of said injectors is encountered in said soil formation in
3 a temporally suitable time related to the curing of the binder
4 and drainage of the water.

1 27. (Previously Amended) The method of claim 20 in which the
2 emission of water is determined by a program responsive to data
3 from a representative core.

1 28.(Original) The method of claim 20 in which the emission of
2 water is determined by a program responsive to data relating to
3 water content already in the soil derived from a sensor on said
4 tool disposed at an axial location below the place of injection
5 of said binder.

1 29. (Original) The method of claim 20 in which the pressure
2 of the stream of water and of the binder in the tool is above the
3 ambient pressure which exists in the formation.